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Unified Air-Ground IP Networks

Ground Infrastructure

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Introduction

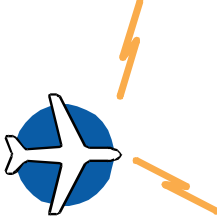
- **Emergence of IP Networking for Aviation**
- **SITA Gatelink**
- **SITA FlightLink – Inmarsat Swift64**
- **VDL Mode 2/IP**
- **Unified on-board and Ground IP Networking**
- **IP Mobility and Intelligent Routing**
- **IP Datalink Security**

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Emergence of IP Networking for Aviation

- **Passenger Applications**
 - Web Access, Corporate E-mail, Corporate VPN, SMS
- **Cabin Applications**
 - Flight Attendants Reports, On-board Sales
- **Cockpit Applications**
 - Engine Monitoring, Aircraft Operational Manual Performance, Navigation Databases Update
- **Available Media**
 - Gatelink, Inmarsat Swift64, Broadband Satellite
 - Potential VDL M2/IP as enabler for bit-oriented application

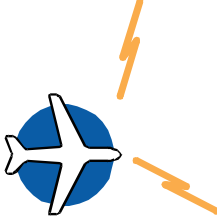


Gatelink

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Gatelink

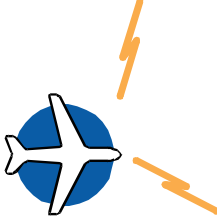


- **IEEE 802.11 defines a standard for Wireless LAN communications:**
 - 802.11b (11Mbps – 2.4GHz), 802.11g (54Mbps – 2.4 GHz), 802.11a (5-6 GHz – 54 Mbps)
 - Link layer is seen as a standard MAC layer by higher level protocols (e.g. IP)
 - Security WEP, 802.1x → still evolving
- **Networking principles**
 - IP based communications
 - Use of private addresses at airports
 - Network Address Translation (NAT) required.

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Gatelink: AEEC 763

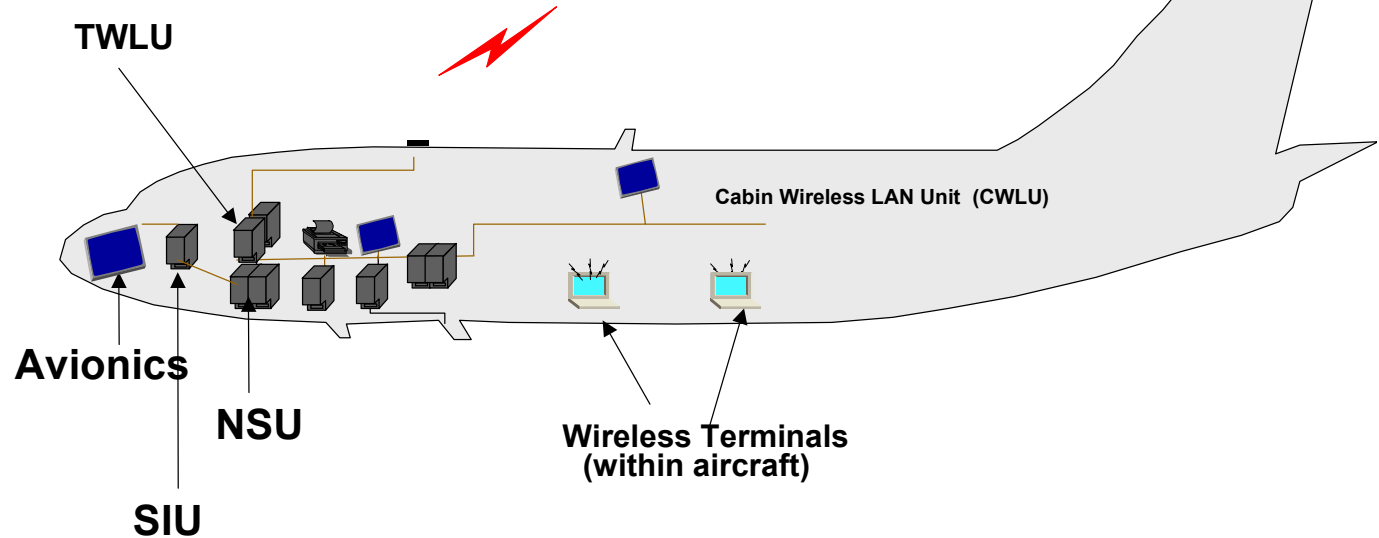


- **Characteristics 763 defines:**
 - **On-board equipment**
 - **Wireless LAN bearer on-board**
 - Terminal Wireless LAN Unit - TWLU
 - FHSS recommended (dual-mode FHSS/DSSS optional)
 - 802.11 suites is being integrated in the standard
 - **Network Server Sytem (NSS)**
 - **Cabin Wireless LAN Unit (CWLK)**

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Gatelink: On-Board Equipment

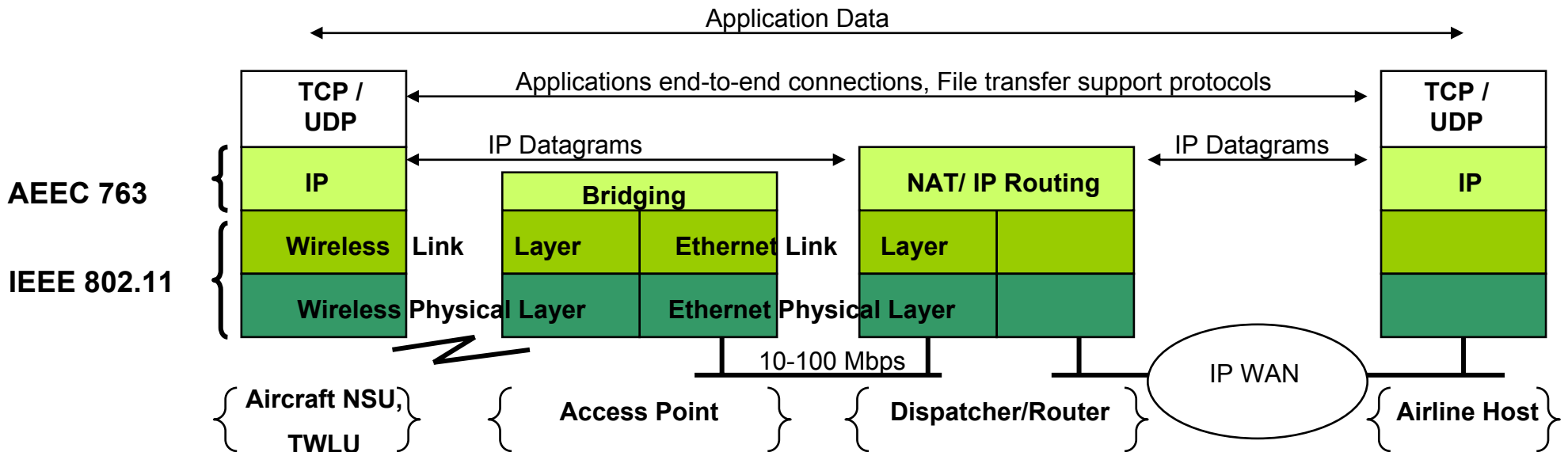
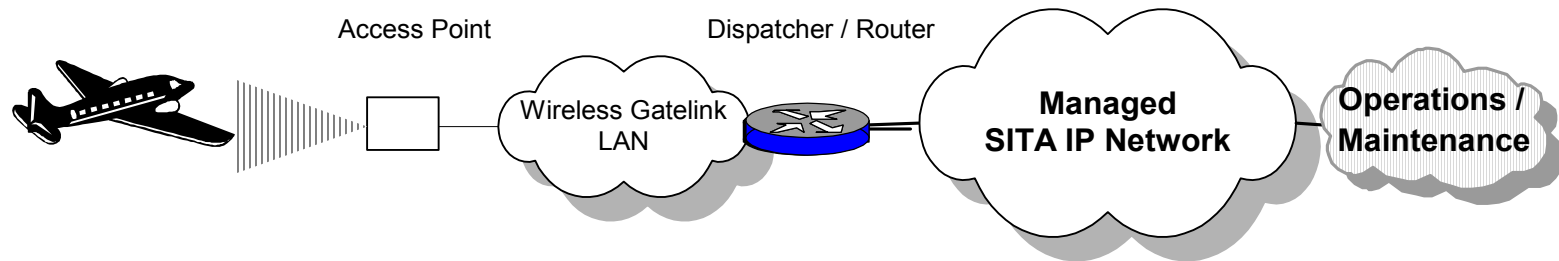


- **NSS composed of:**
 - **Network Server Unit (NSU)**
 - both a file server and IP router
 - NT System offering Ethernet Interfaces
 - **Server Interface Unit (SIU)**
 - addresses legacy avionics end-systems

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Gatelink Networking



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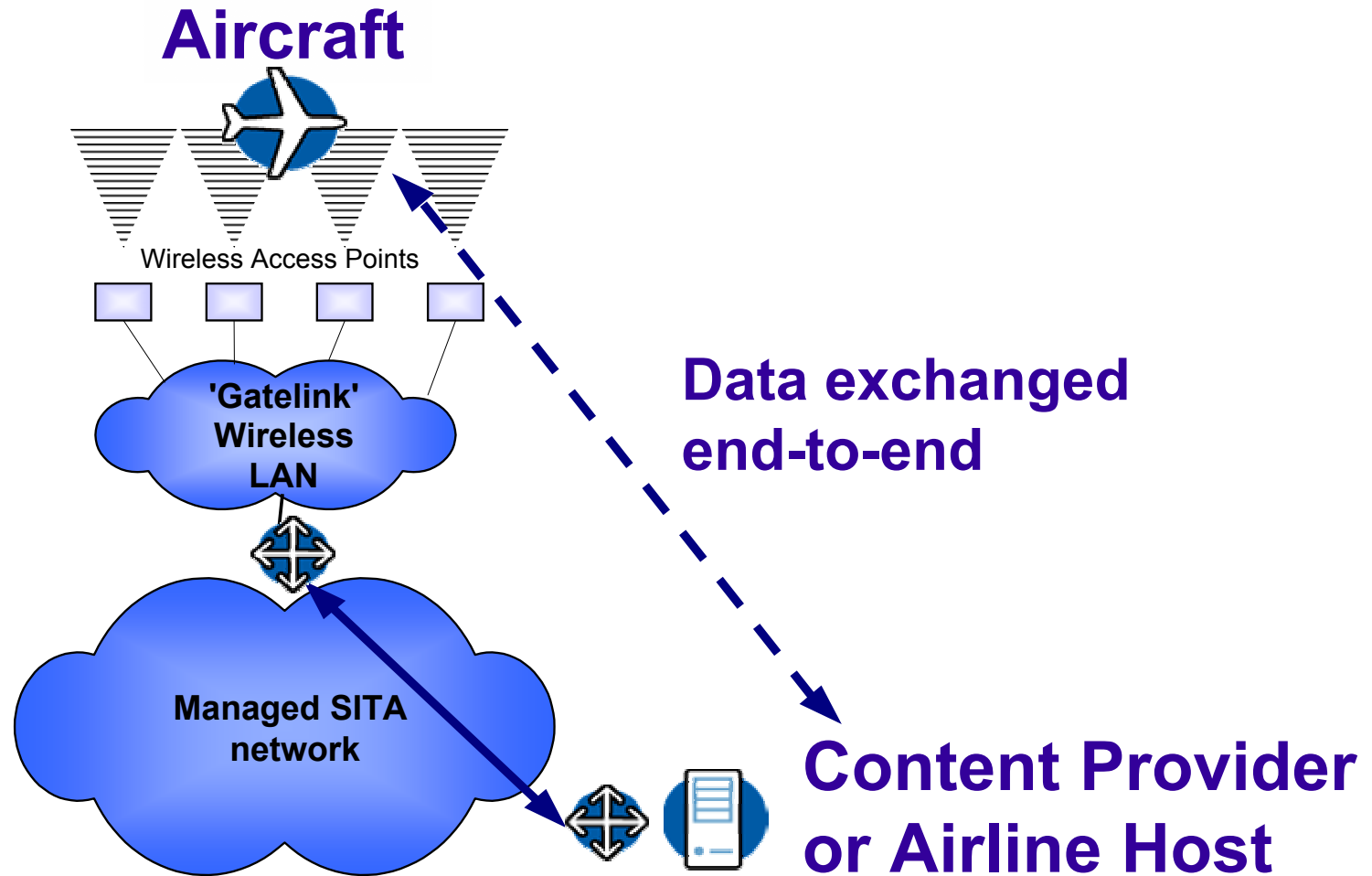
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Gatelink: Security



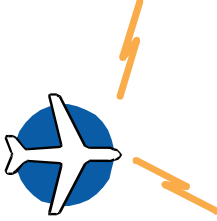
- **Security function**
 - **Confidentiality and integrity**
 - IEEE 802.11 standard specifies Wired Equivalent Privacy (WEP)
 - WEP may be used for pilot projects only
- **Authentication**
 - IEEE 802.11 standard specifies shared key mechanism
 - Not a scalable solution - IEEE working on a better solution
 - MAC address filtering
 - Not super safe but provides a minimum of protection
 - recommended to be used for pilot installations

Gatelink: End-to-end Solution



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FlightLink – Swift64

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SITA FlightLink- Inmarsat Swift64

- SITA Flightlink Services
- SITA Flightlink Functions
- SITA Infrastructure Overview

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SITA Flightlink Services

IP-based Services

IP access over MISDN

- Based on Inmarsat Swift64 Mobile ISDN Service
- IP end-to-end communication service
 - Over an ISDN connection; and
 - Over SITA IP network
- Air to Ground initiated connection (Link Layer)

Mobile Packet Data Service (MPDS)

- Based on Inmarsat Swift64 MPDS
- IP end-to-end communication service over SITA IP network
- Air to Ground initiated connection (Link Layer)
- Mobility management

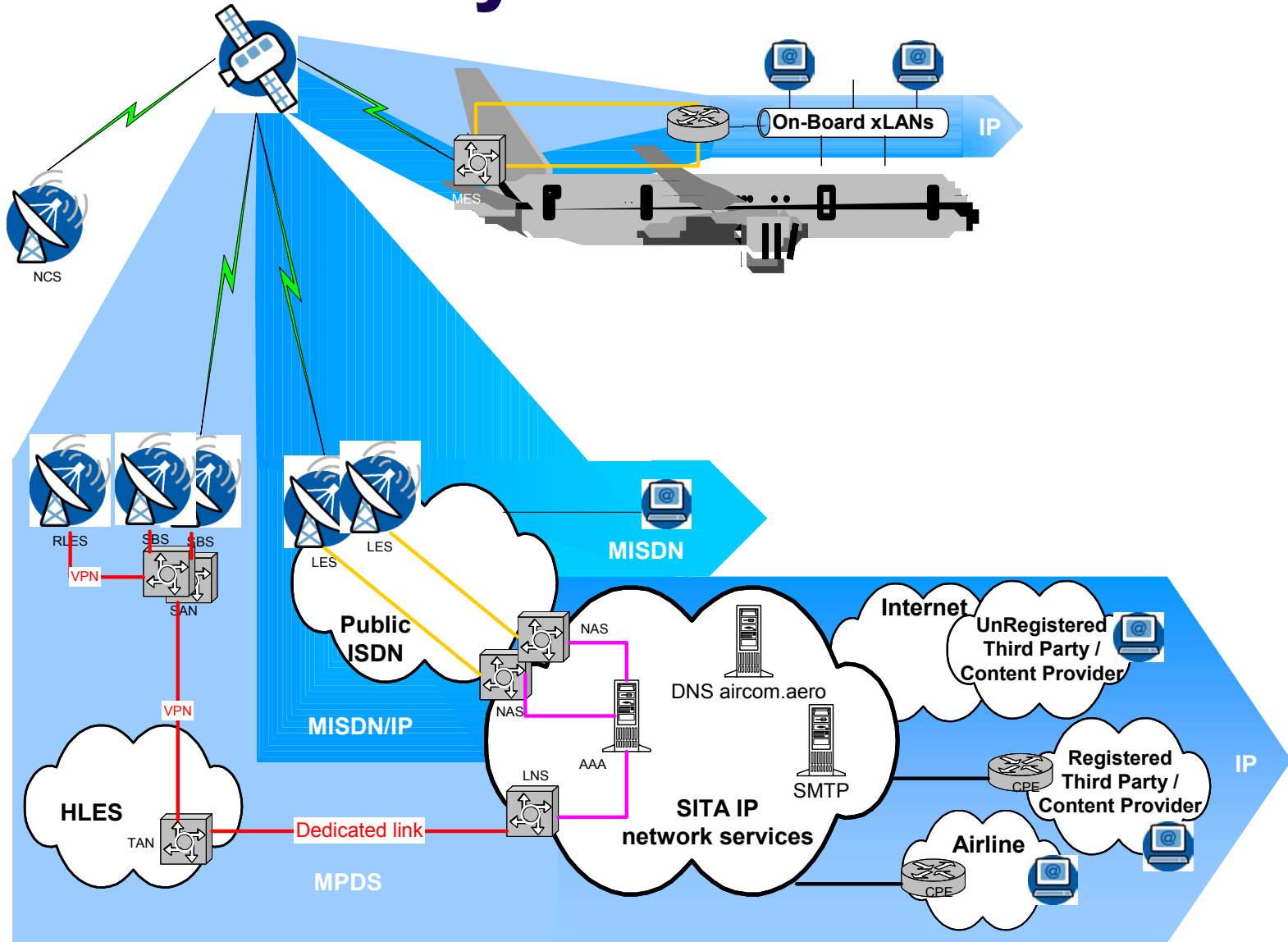
Mobile ISDN

- Based on Inmarsat Swift64 Mobile ISDN Service
- Air to ground and ground to air initiated connection
- Mobility management

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End-to-End System Architecture



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SITA Flightlink Functions

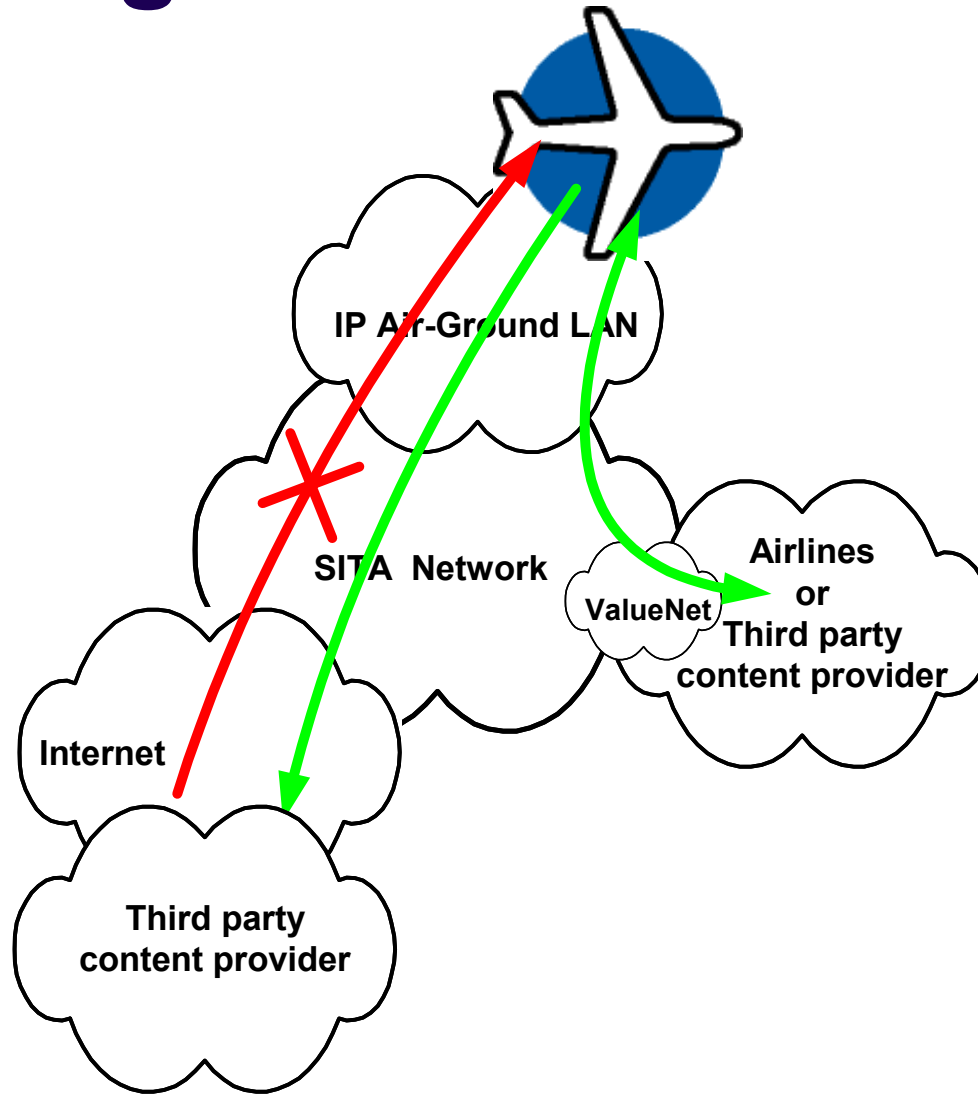
- **Routing management**
- **Security**
 - Authentication
 - Authorization and data routing control
 - Supervision and security controls
 - End-to-end data protection
- **Mobility management**

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Routing : IP Traffic Control



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Routing : IP Address allocation

- **Support for three kind of IP allocation schemes**
 - ARINC 763 → Static private address (10.0.0.0/8)
 - Dynamic IP pool allocation
 - Public static IP addresses
 - Should allow on-board servers to be reachable for ground to air communication → Ground Mobility Management
 - Maximum of 4 static public IP addresses per aircraft
 - Four kinds of targeted on-board servers identified
 - Passenger
 - Cockpit
 - Cabin crew
 - Spare

Security



- **Authentication**
- **Authorization**
- **Supervision and security controls**
- **End-to-end data protection**

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Authentication

- **Authentication of Aero-MESs accessing SITA IP Network via AIRCOM Flightlink services:**
 - Authentication server: AAA
 - Challenge password: CHAP
 - Aero-MES identification control

Authorization

- **Management of Aero-MESs Authorization accessing the SITA IP network via the AIRCOM Flightlink services**
 - Authorization server: AAA
 - Access control list and filtering: Firewall
 - Management and control of IP data routes: Firewall

Supervision and Security Controls

- **Security and network supervision**
 - **Security monitoring at network level**
 - **Data scanning**
 - **Probe management**
 - **Audit trails, especially on unauthorized access attempts**

Data Protection

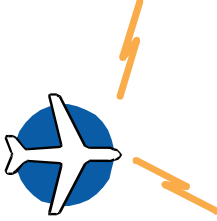
- Integrity and confidentiality may be managed in two ways:
 - Encryption at Customer Application level
 - SSL/TLS Secure Protocols
 - SITA Comm. Security (e.g. IPsec and Certificate management)

Mobility Management AIRCOM Flightlink MPDS

- **Satellite Mobility Management**
 - Handover between spot beams in the same ocean region for MPDS
 - Future: Handover between satellites
- **Ground Mobility Management**
 - Permanent connection to the ground
 - Benefit of SITA DNS infrastructure

Ground Mobility Management

- AIRCOM Flightlink MPDS allows Aircraft to be permanently connected to the SITA IP ground infrastructure
 - Could act as a signaling channel permanently reachable by ground hosts
 - On-board server may be reachable by a DNS name.
 - e.g. : maintenance.<tail>.<airline>.mpds.aircom.aero
 - AIRCOM DNS registration may be integrated with the top-level-domain “.aero”



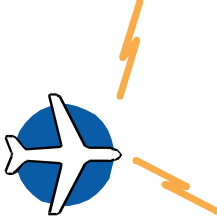
IPoV

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IP Over VDL Mode 2

- **Potential Extension to current AOA definition**
 - Just Food for Thought at this point
 - **Enabler for Cockpit bit-oriented applications**
 - Graphical weather updates, Electronic Flight Bag etc ..
 - Airline content
 - **Several solutions to be evaluated:**
 - IP over AVLC using IPI/EPI field
 - IP/PPP over AVLC to benefit from PPP established facility
 - IP over 8208 (defined in IETF RFC)
 - IP/PPP over 8208

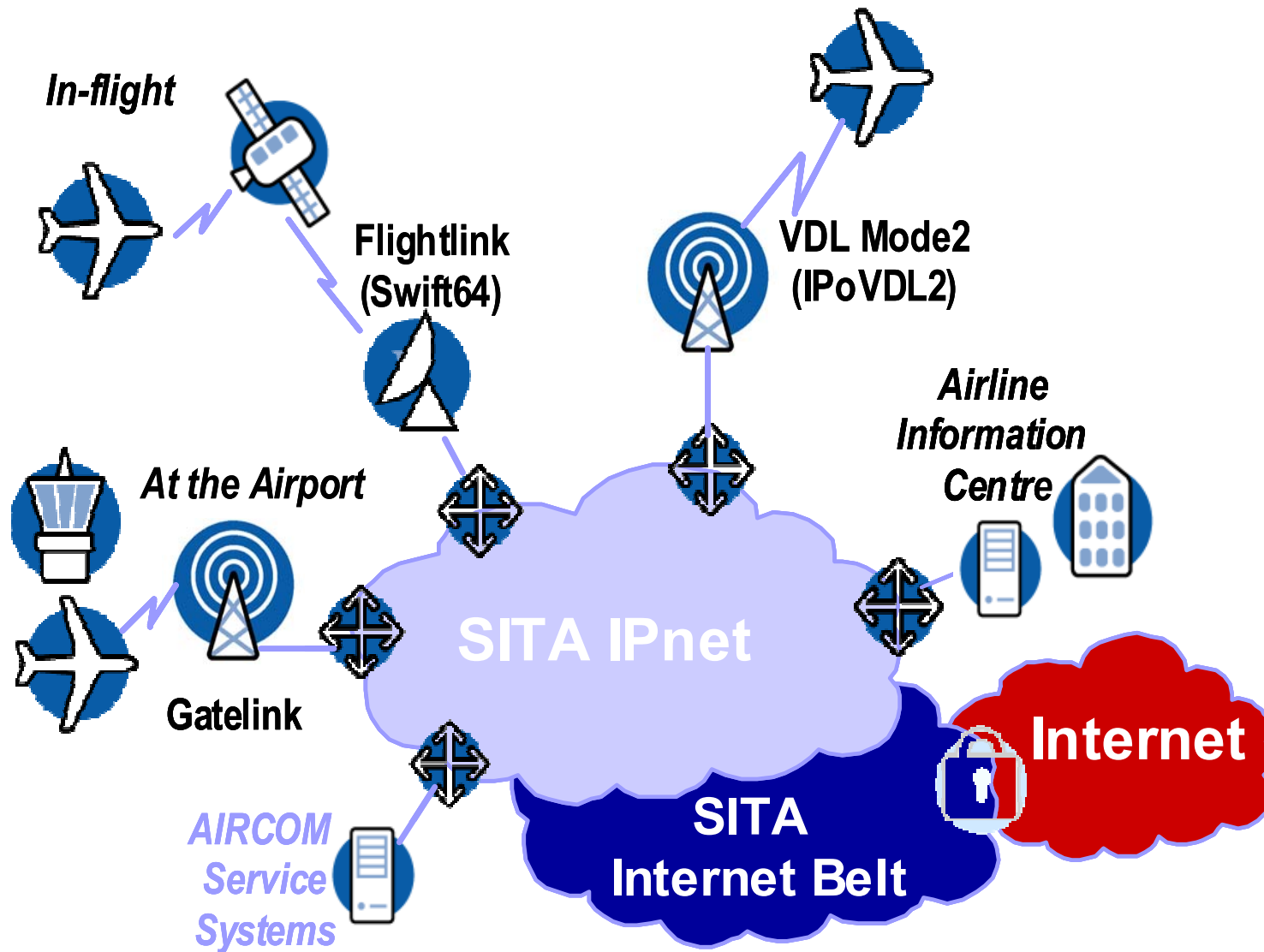


Unified IP

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Unified IP Networks



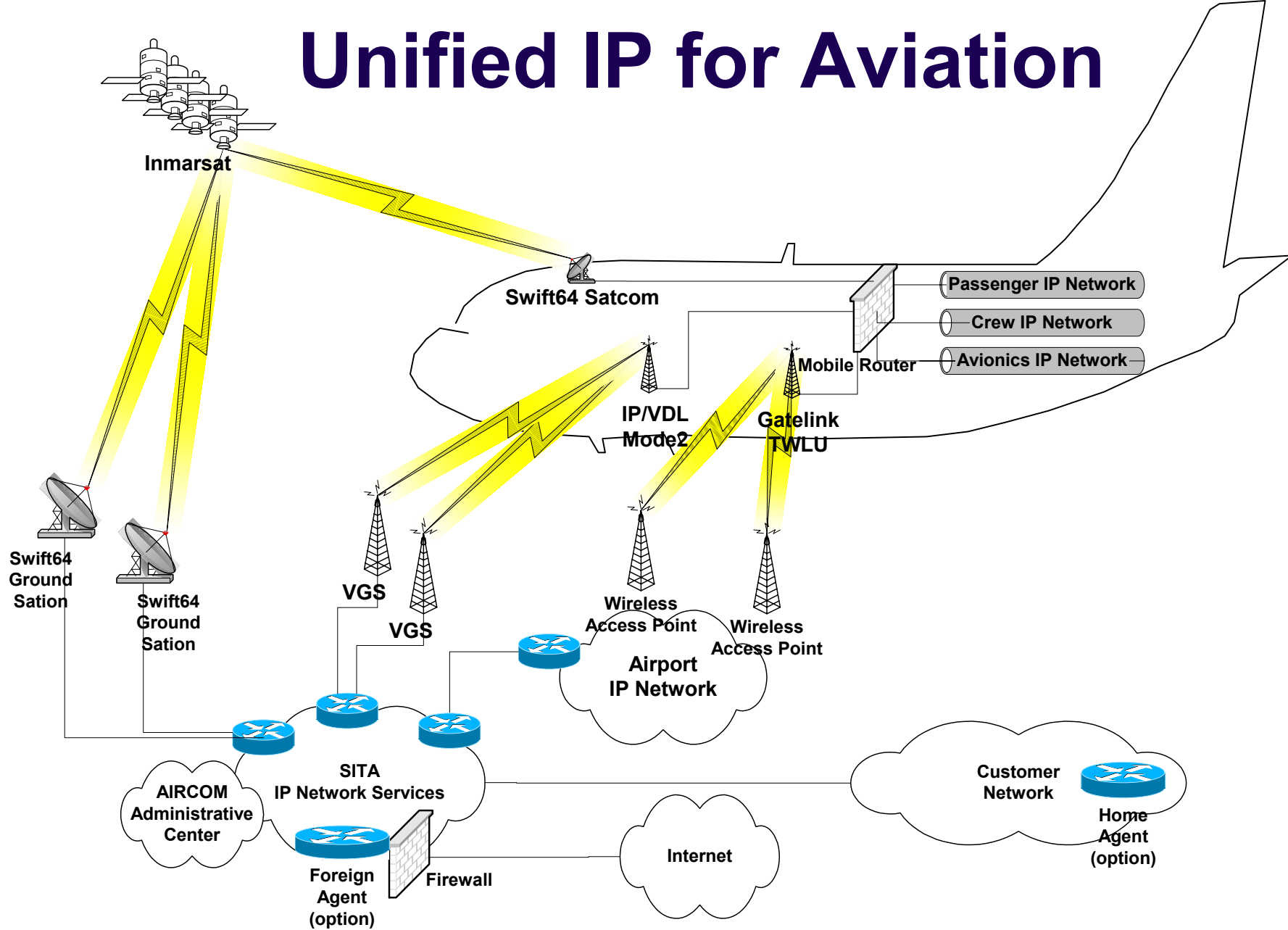
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Mobility Management

- **Handoffs within same subnet supported**
 - Spot beam handoffs for MPDS
 - VDL2 ground Station Hand
 - Inter Wireless Access Point Handoffs as well inter-Airport
- **Parallel use of media**
 - Route IP datagram to available media without breaking TCP/IP connections
 - Potential use of Mobile IP
 - Need to use NAT traversal techniques and apply reverse tunneling
 - Foreign Agent hosted at the Service Provider level
 - Similar as a central DSP concept

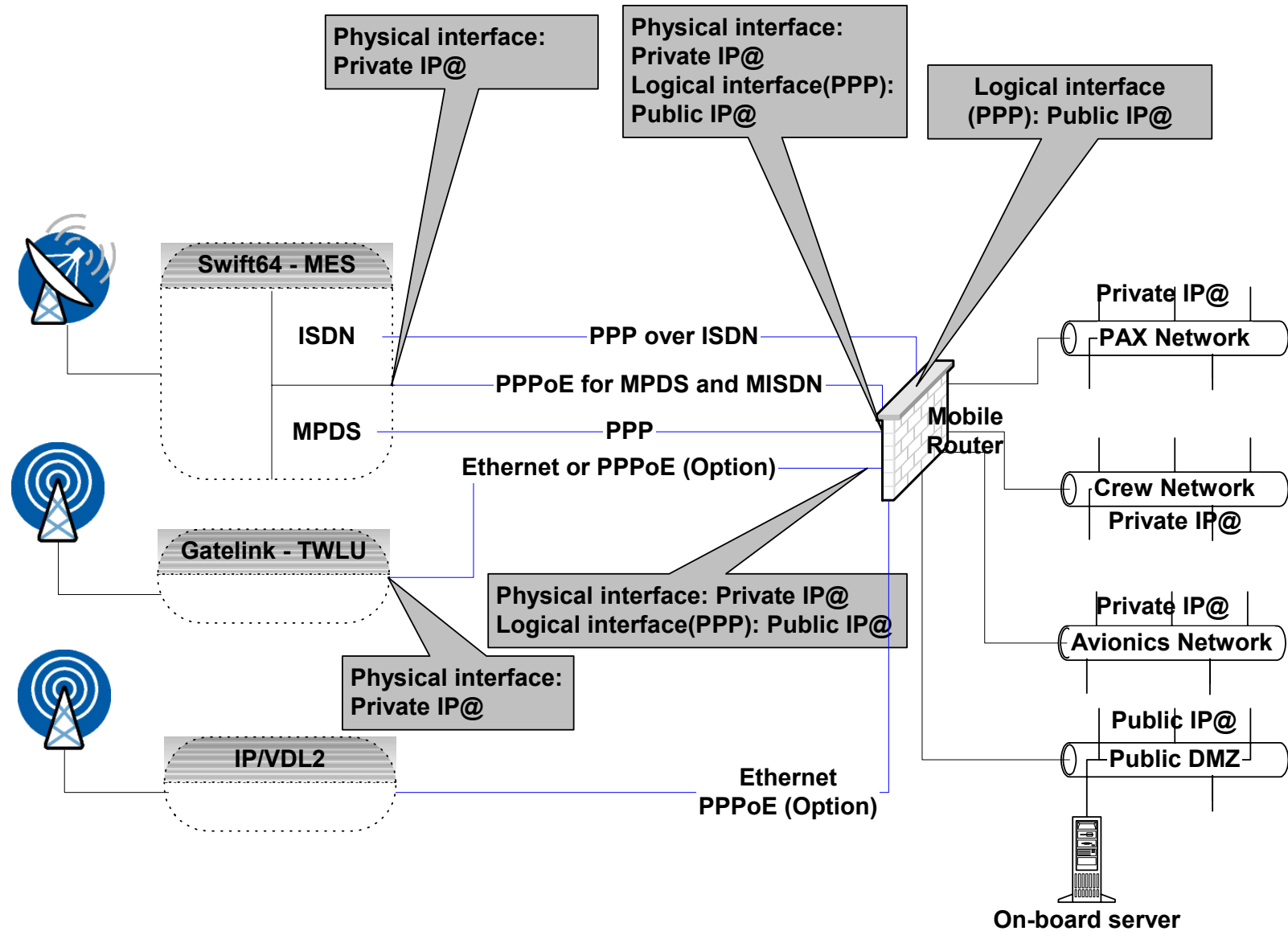
Unified IP for Aviation



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Unified IP – On-board Example



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Intelligent Routing

■ Mobile IP

- only defines media-independent procedures by which a Mobile Node can maintain existing transport and application-layer connections despite changing its point-of-attachment to the Internet

■ On-Board Router to select best media

- QoS based selection (availability, transit time, cost etc ..)
- Application based selection (5 MB file won't pass through VDL2)
- Partly addressed by IPV6

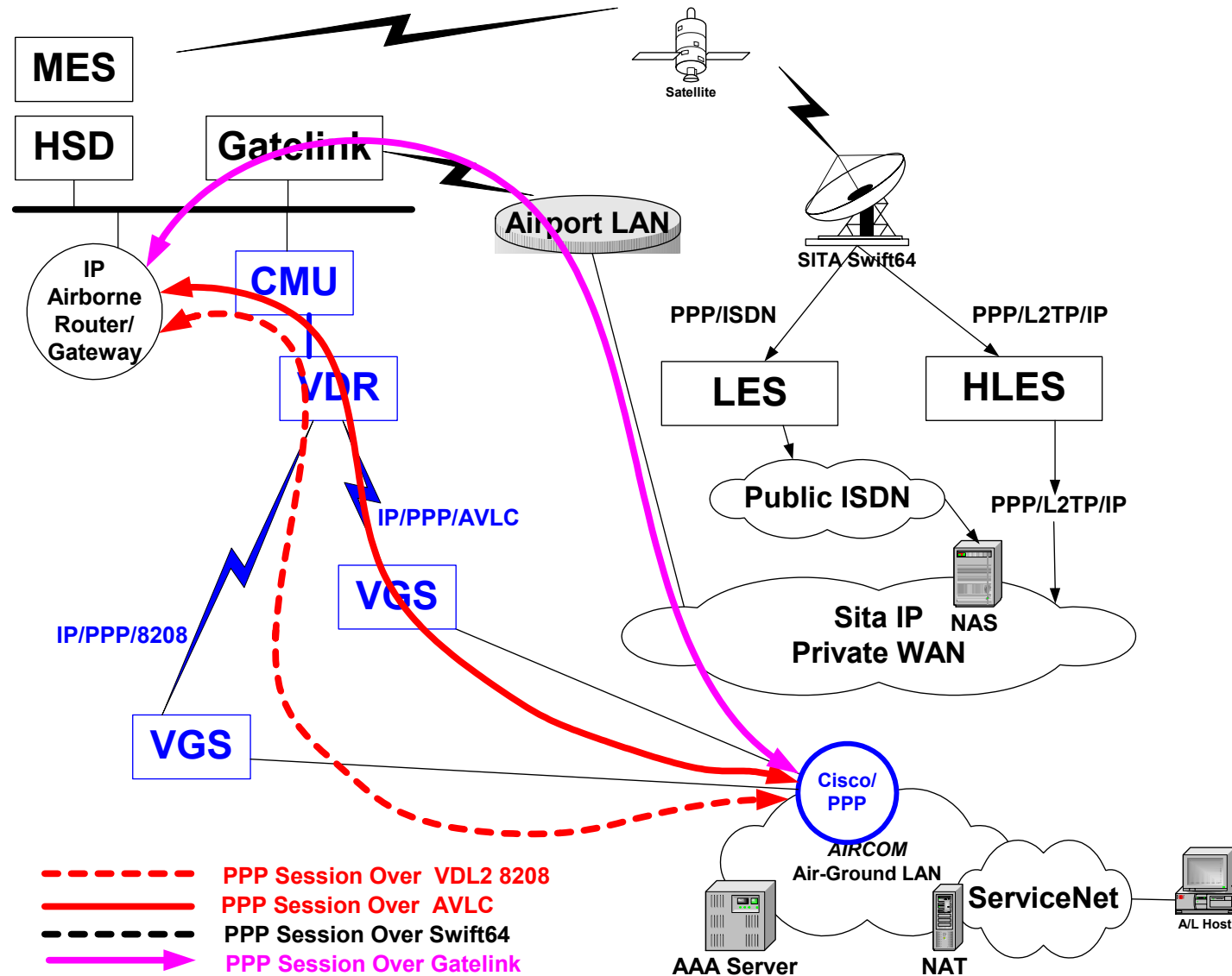
■ Need for more analysis to establish best strategy

- Need to learn from ATN experience and dynamic routing

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A/G and G/G IP integration vs PPP

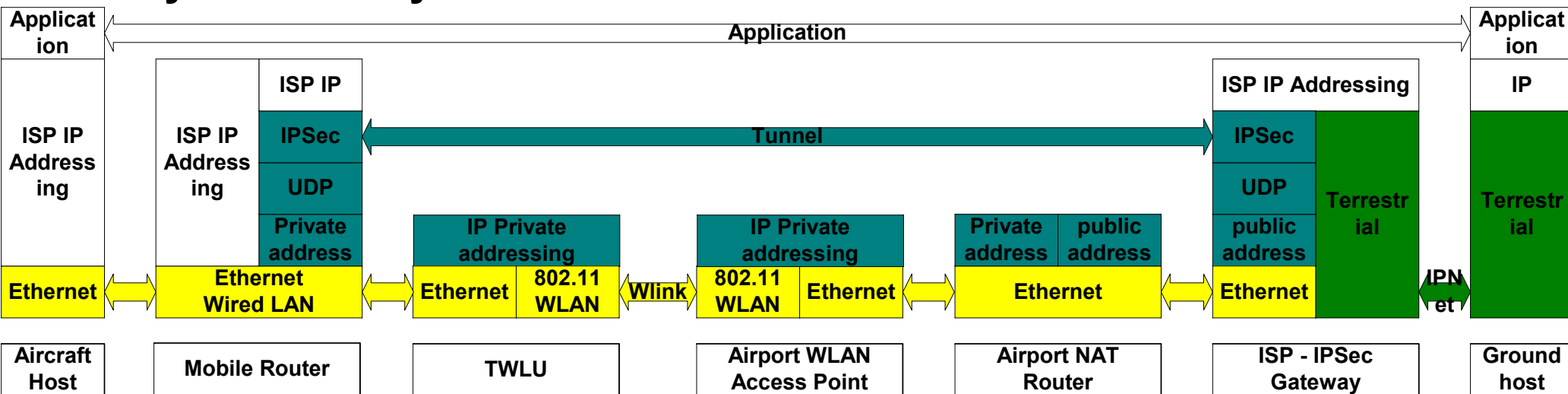


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Comms Security – IPsec example

Gateway to Gateway IPsec with NAT Traversal over Gatelink



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Questions/comments ?



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